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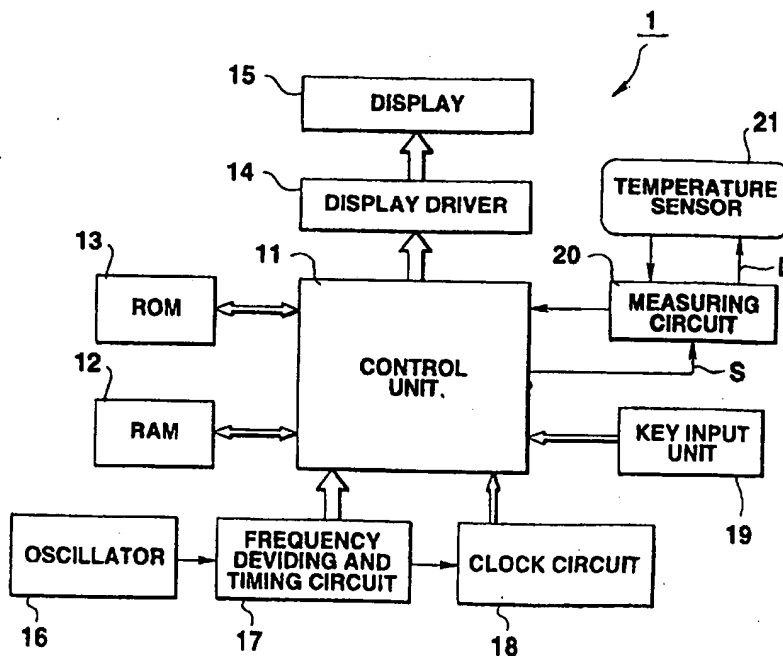
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(54) Title: ELECTRONIC DEVICE WITH SENSOR

(57) Abstract

An electronic device with a sensor displays in colors, in accordance with values measured by the sensor, information associated with the values. When a temperature measurement mode is selected, a control unit (11) causes a temperature sensor (21) and a measuring circuit (20) to detect a temperature of snow, and writes data of the detected temperature of snow in a temperature data register (C) of a display register (40) of a RAM (12). The control unit (11) also reads display color data, corresponding to a company name of a ski wax maker stored in a company name register (N) of the RAM (12) and a value of the temperature data register (C) of the display register (40), from a color conversion table of a ROM (13) which stores display color data representing index colors of ski wax of the respective ski wax makers. The control unit (11) causes a display unit (15) to display the company name stored in the company name register (N) and the data of detected temperature of snow stored in the temperature data register (C) in the color corresponding to the display color data stored in the display color register (L) of the display register (40).



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D E S C R I P T I O N
ELECTRONIC DEVICE WITH SENSOR

Technical Field

The present invention relates to an electronic
5 device with a sensor, which displays information
corresponding to a value measured by the sensor.

Background Art

Conventionally, an electronic device is known
which includes a pressure sensor or temperature
10 sensor and displays a value measured by the sensor.
For example, an altimeter or sounding machine displays
an altitude or depth of water based on pressure data
measured by a pressure sensor. An electronic
thermometer or clinical thermometer displays on
15 a display unit atmospheric temperature data or body
temperature data measured by a temperature sensor
incorporated therein.

The conventional electronic device with a sensor,
as described above, displays only a value measured by
20 the sensor, and cannot display other information based
on the measured value.

Disclosure of the Invention

The present invention has been made to solve the
aforementioned problem of the conventional device, and
25 its object is to provide an electronic device with
sensor which can display not only a value measured by
the sensor but also information based on the measured

value.

To achieve the above object, according to the present invention, there is provided an electronic device with a sensor comprising a sensor; a sensor driving circuit for driving the sensor, thereby
5 obtaining data of measurement values; a display capable of performing color display; a storage unit for storing data of display colors respectively corresponding to the data of the measurement values obtained by the
10 sensor driving circuit; a reader for reading data of a display color corresponding to data of a measurement value obtained by the sensor driving circuit from the data of display colors stored in the storage unit; and a display controller for driving the display to perform
15 display in a color corresponding to the data of the display color read by the reader.

With the above structure, the electronic device with a sensor of the present invention can display information corresponding to values measured by the
20 sensor in colors associated with the values. Thus, since information other than the measured value can be displayed, the operability of the device is increased.

Brief Description of the Drawings

FIG. 1 is a front view of an electronic watch
25 according to an embodiment of an electronic device with a sensor of the present invention;

FIG. 2 is a block diagram showing circuits of

the electronic watch shown in FIG. 1;

FIG. 3 is a diagram showing a structure of the RAM shown in FIG. 2;

FIG. 4 is a diagram showing a color conversion
5 table stored in the ROM shown in FIG. 2;

FIG. 5 is a diagram for explaining switching operations executed by a control unit;

FIG. 6 is a flowchart for explaining processes executed by the control unit;

10 FIG. 7 is a flowchart for explaining a display process executed by the control unit; and

FIG. 8 is a diagram showing another structure of the RAM shown in FIG. 2.

Best Mode of Carrying Out the Invention

15 A preferred embodiment of the present invention will be described with reference to the accompanying drawings.

FIG. 1 is a front view of an electronic watch to which the present invention is applied.

20 As shown in FIG. 1, watch bands 32a and 32b are attached to upper and lower sides of a watch case 31. A display 15 is arranged in a central portion of the watch case 31 under a glass 33. A mode change switch K1 and a temperature measurement switch K2 are arranged
25 in a lower portion of the surface of the watch case 31. A maker set switch K3 and a time adjustment switch K4 are arranged on a right side of the watch case 31.

A detection groove 34 is formed in an upper left portion of the watch case 31 and a temperature sensor 21 of a radiation thermometer is arranged in an inner portion of the detection groove 34.

5 FIG. 2 shows a circuit structure of the electronic watch as described above.

Referring to FIG. 2, the electronic watch comprises a control unit 11, a RAM 12, a ROM 13, a display driver 14, a display 15, an oscillator 16, a frequency-dividing and timing circuit 17, a clock
10 circuit 18, a key input unit 19, a measuring circuit 20 and a temperature sensor 21.

The key input unit 19 includes the mode change switch K1, the temperature measurement switch K2, the
15 maker set switch K3 and the time adjustment switch K4, for setting various modes of the electronic watch and processes in the modes.

The oscillator 16, which is made up of, for example, a quartz oscillator, outputs an oscillating
20 frequency signal of a predetermined period to the frequency-dividing and timing circuit 17.

The frequency-dividing and timing circuit 17 frequency-divides the oscillating frequency signal supplied from the oscillator 16. It supplies a system
25 clock signal for controlling the overall circuits and various timing signals to the control unit 11. It also supplies a clock signal to the clock circuit 18.

The clock circuit 18 clocks time based on clocks supplied from the frequency-dividing and timing circuit 17. It generates time data representing the current time, consisting of the year, month, date, hour, minute and second, and supplies it to the control unit 11.

The display driver 14 is operated under control of the control unit 11, and causes the display to display the time data transferred from the clock circuit 18 or the display data transferred from a display register 40 of the RAM 12.

The display 15 is comprised of, for example, a reflection type liquid crystal color display panel, and displays the time data or display data transferred from the register 40 of the RAM 12.

The temperature sensor 21 is, for example, an infrared detection type sensor. It operates in response to a drive signal D supplied from the measuring circuit 20, detects the amount of infrared rays emitted from an object to be measured, and outputs a voltage signal corresponding to the amount to the measuring circuit 20.

The measuring circuit 20, which is driven in reply to an operation signal S supplied from the control unit 11, outputs the aforementioned drive signal D. In addition, based on the voltage signal supplied from the temperature sensor 21, the measuring circuit 20

calculates temperature data by means of
a voltage-temperature conversion table stored in
a ROM (not shown) or a calculator, and supplies the
obtained temperature data to the control unit 11.

5 The temperature data is written in a temperature data
register T of the display register 40 of the RAM 12
(to be described later) by the control unit 11.

FIG. 3 shows memory areas of the RAM 12. The RAM
12, including the display register 40, is used as
10 a work memory of the control unit 11. The display
register 40 stores data to be displayed on the
display 15. The RAM 12 also includes a mode flag
register area M, a display color register area L,
a company name register area N, a temperature data
15 register area C, and so on.

The mode flag register M stores mode data
representing a display mode. When the value stored
in the mode flag register M is "0" (hereinafter
represented like M="0"), a time display mode is
20 selected and the display 15 displays the current time.
When M="1", a temperature measurement mode is selected
and the display 15 displays the name of the ski wax
manufacturing company and the temperature of snow in
an index color of ski wax corresponding to the measured
25 temperature of snow.

The display color register area L stores one or
two pieces of display color data read from a color

conversion table in the ROM 13. The display 15 displays a color corresponding to the display color data stored in the display color register.

5 The company name register N stores the name of a manufacturing company of a color wax for skies. For example, N="0", "1" and "2" denote the company names, "Company A", "Company B" and "Company C", respectively.

10 The temperature data register area C stores temperature data representing the temperature of snow detected by the temperature sensor 21 and the measuring circuit 20.

The ROM 13 stores various programs and data, and the color conversion table as shown in FIG. 4.

15 The color conversion table shown in FIG. 4 stores snow temperatures and index colors (the colors of the boxes of the ski wax) of ski wax of the respective ski wax manufacturing companies, suitable for the respective temperatures. Two of the display color data 20 "1" to "6" are indicated for each company and temperature.

The display color data "0" to "5" respectively denote the colors "black", "blue", "red", "orange", "yellow" and "green" (although "0" is not indicated 25 in the table of FIG. 4, the current time is displayed with the color (black) corresponding to the data "0"). The display data "6" represents that no data is stored.

The display data of the color conversion table are read by the control unit 11.

For example, in the display register 40, when the mode flag register stores M="1" (representing the temperature measurement mode), the company name register stores N="0" (Company A), and the temperature data register stores C="-6", the corresponding display color data "2" is read from the color conversion table and written in the display color register L. In the same manner, when the temperature data register area stores "-5", the display color data "3" and "2" are read from the table and written in the display color register L.

The control unit 11, comprised of a CPU (central processing unit), executes processes shown in the flowcharts of FIGS. 6 and 7 in accordance with microprograms stored in the ROM 13. Although operations represented by the flowcharts will be described in detail later, an outline thereof will be first described.

First, when the temperature measurement switch K2 of the key input unit 19 is depressed to select the temperature measurement mode, the control unit 11 causes the temperature sensor 21 and the measuring circuit 20 to measure the temperature of snow, and causes the temperature data register C of the RAM 12 to store the obtained temperature data. Then, the control

unit 11 discriminates the value of the company name register N of the RAM 12, and reads, from the color conversion table of the ROM 13, display color data corresponding to the temperature data stored in the temperature data register C and the company name stored
5 in the company name register N. The control unit 11 writes the display color data read from the table into the display color register L.

For example, when the mode flag register M of the display register 40 stores data M="1" (the temperature
10 measurement mode), the company name register N stores data N="0" (the company A) and the temperature data register C stores data C="-6", the control unit 11 reads the display color data "2" from the color
15 conversion table of the ROM 13, and writes it into the display color register L of the RAM 12.

Further, when the control unit 11 identifies the value of the mode flag register M of the RAM 12 as M=0, i.e., the time display mode, it writes the display
20 color data "0" representing the color "black" into the display color register L of the display register 40, and causes the display 15 to display in black the current time data, consisting of the year, month, hour, minute, second and so on, obtained from the
25 clock circuit 18.

On the other hand, when the control unit 11 identifies the value of the mode flag register M of

the RAM as M=1, i.e., the temperature measurement mode, it causes the display 15 to display, in the color corresponding to the value stored in the display color register L, the temperature corresponding to the value stored in the temperature data register T and the company name corresponding to the value stored in the company name register N.

For example, when the mode flag register M stores data M="1" (the temperature measurement mode), the company name register N stores data N="0" (the company A), the temperature data register C stores data C="-6", and the display color register L stores the data L="2", the control unit 11 causes the display 15 to display "Company A" and "-6°C" in red.

FIG. 5 shows a state in which the value in the mode flag register M of the RAM 12 is renewed by operating the mode change switch K1, thereby changing the mode. When the value of the mode flag register M is 0 (M="0"), the time display mode is selected and the display 15 displays current time data including the year, month, date, hour, minute, second and so on.

In the time display mode, when the mode change switch K1 is operated, the value of the mode flag register M is incremented by "1" (M="1"), so that the mode is switched to the temperature measurement mode. The display in the temperature measurement mode has already been described above. In the temperature

measurement mode, when the mode change switch K1 is operated, the value of the mode flag register M is decremented by "1" (M="0"), so that the mode is switched to the time display mode.

5 The above operation will be now described with reference to the flowcharts of FIGS. 6 and 7.

Referring to FIG. 6, first, the control unit 11 determines whether a switch (e.g., the switch keys K1 to K4 of the key input unit 19) is operated (Step S1).
10 When it is determined that a switch is operated, it is further determined whether the operated switch is the temperature measurement switch K2 for measuring a temperature (Step S2). On the other hand, when it is determined in Step S1 that no switch is operated,
15 the flow advances to a display process in Step S11.

When it is determined in Step S2 that the temperature measurement switch K2 is depressed, the control unit 11 causes the temperature sensor 21 and the measuring circuit 20 to measure the temperature of
20 snow, writes the measured temperature data into the temperature data register C of the RAM 12 (Step S3). Further, the control unit 11 identifies the value stored in the company name register N (Step S4), reads from the color conversion table of the ROM 13 display
25 color data corresponding to the ski wax index color based on the temperature data stored in the temperature data register T in accordance with the value of the

company name register N, and writes the display color data into the display color register L (Steps S5 to S7). More specifically, the control unit 11 discriminates the value of the company name register N from "0", "1" and "2", reads the value of the temperature data register T from the color conversion table of the ROM 13, and writes the read data into the display color register L. Then, the flow advances to Step S11 to execute a display process.

For example, when the company name register N stores "0" which represents Company A, the flow advances to Step S5. If the temperature data register C stores the value "-8", the display color data "2" and "1" are read from the color conversion table in the ROM 13, and written in the display color register L of the display register 40. Then, the flow advances to Step S11.

When it is determined in Step S2 that the temperature measurement switch K2 is not depressed, it is determined whether the maker set switch K3 is depressed (Step S8). If the maker set switch K3 is depressed, the value of the company name register N is incremented by "1" and the flow advances to Step S11. If the maker set switch K3 is not depressed, the flow advances to Step S10 for executing the other key processes, for example, the mode change process when the mode change switch K1 is depressed, and the time

set or adjustment process when the time adjustment switch key K4 is depressed (Step S10). Then, the flow advances to Step S11 for executing a display process as shown in the flowchart of FIG. 7, that is, the display mode process is completed.

The display process of Step 11 shown in FIG. 6 will now be described with reference to the flowchart shown in FIG. 7.

Referring to FIG. 7, first, the control unit 11 determines whether the value of the mode flag register M of the display register 40 of the RAM 12 is "0" or "1" (Step S21). If the value is determined to be "0" (the time display mode), the control unit 11 writes the display color data "0" representing "black" into the display color register L (Step S22), and causes the display 15 to display, in black, time data including the current year, month, date, hour, minute, second and so on obtained by the clock circuit 18. Then, the display process is completed.

In Step S21, if the control unit 11 determines that the value of the mode flag register M is "1" (the temperature measurement mode), the flow advances to Step S25, in which it is determined whether temperature data is stored in the temperature data register C. If temperature data is not stored, the control unit causes the display 15 to display in black only the company name corresponding to the value of the company

name register N (Step S28). On the other hand, if the control unit 11 determines that temperature data is stored in the temperature data register C, it determines the number of pieces of display color data stored in the display color register L (Step S26).
5 If the number of pieces of the display color data is determined to be 1, the control unit 11 causes the display 15 to display the company name and the temperature in the one color corresponding to the display color data (Step S24). Then, the display
10 process is completed.

For example, if the value of the display color register L is "2" representing "red", the value of the company name register N is "0" representing "Company A" and the value of the temperature data register C is
15 "-6", the display 15 displays "Company A/-6°C" in red.

In Step S26, if the number of pieces of the display color data is determined to be 2, the control unit 11 causes the display 15 to display the company name and the temperature in different colors
20 (Step S27). Then, the display process is completed. For example, if the values of the display color register L are "2" and "1" representing "red" and "blue", the value of the company name register N is
25 "0" representing "Company A" and the value of the temperature data register C is "-9", the display 15 displays "Company A" in red and "-9°C" in blue.

Then, the display process is completed.

As described above, according to the above embodiment, since the index color of hot ski wax, corresponding to the temperature obtained by the measurement of snow temperature, is color-displayed on the display unit, the user can select suitable hot ski wax easily and reliably.

Further, in the above embodiment, since a reflection type liquid crystal color display panel is used in the display unit, high-quality color display can be obtained with a simple structure at a low cost.

The above embodiment is constructed so as to select the most suitable hot ski wax based on the result of snow temperature measurement; however, it is possible to use a snow temperature and an atmospheric temperature as indexes to select hot ski wax.

Further, although a reflection type liquid crystal color display panel is used in the display 15 in the above embodiment, the present invention is not limited to this embodiment, and a display of any type can be used, so long as it can perform multicolor display. For example, it is possible to perform multicolor display by means of EL (electroluminescence) elements.

Furthermore, in the above embodiment, the display unit of an electronic watch displays the company name of hot ski wax and the snow temperature in an index

color of the hot ski wax corresponding to the snow
temperature obtained by the measurement. However, the
present invention is not limited to this embodiment.
Desirable information or detection value, other than
5 a ski wax company name or a snow temperature, may be
displayed in colors having some relation to measurement
values or detection values based on the measurement or
detection of the sensor.

FIG. 8 shows a RAM 40 in a thermometer for
10 measuring an atmospheric temperature. The RAM 40
is incorporated in an electronic device having the
same structure as that shown in FIG. 2 except for the
RAM 40.

Referring to FIG. 8, the user can set desirable
15 temperature data into registers P1 to P5 through the
key input unit 19 (FIG. 2). Temperature data measured
by the temperature sensor 21 is stored in the
temperature data register C. If the stored data is
within the range of the value stored in the register
20 P1, display color data "1" is stored in the register L,
and if the stored data is within the range of the value
stored in the register P2, display color data "2" is
stored in the register L.

With the above RAM, when the atmospheric
25 temperature is 0°C to 4°C, the display color is blue;
when it is 5°C to 10°C, the display color is red; and
when it is 11°C to 13°C, the display color is orange.

If a lower temperature is displayed in whiter or more bluish color and a higher temperature is displayed in more reddish color, it is possible to indicate the degree of the temperature by the display color.

5 In the above embodiment, the display unit performs multicolor display in accordance with the temperature. However, the present invention is not limited to this embodiment. The sensor need not be a temperature
10 sensor, so long as any information related to values measured by the temperature are displayed in different colors.

 For example, assuming that the electronic device of the present invention comprises a pressure sensor for measuring a depth of water, it is possible to set
15 the device as follows. If the information that the user is a beginner diver is set to the device, the depth of water is displayed in black in a relatively shallow region of a depth less than 10 m, and in red in
20 a region deeper than 10 m, so that the user can be informed that it is dangerous to dive deeper. If the information that the user is a middle class diver is set to the device, the display color is switched
25 between black and red at the depth of 30 m. If the information that the user is an expert is set to the device, the display color is switched between black and red at the depth of 50 m.

 Further, in the above embodiment, the company name

data and the measured temperature data themselves are displayed in colors. However, the colors of the background of the display may be changed, while the colors of data remain unchanged.

5 As has been described above, with the electronic device with a sensor of the present invention, information corresponding to values measured by the sensor are displayed in different colors associated with the values. Thus, the operability of the device
10 is increased. For example, if the sensor is to measure snow temperature as in the above embodiment, an index color of hot wax corresponding to the temperature is color-displayed in accordance with the result of the measurement. Therefore, the user can select ski wax
15 easily and reliably.

C L A I M S

1. An electronic device with a sensor comprising:
sensor means;
sensor driving circuit means for driving the
5 sensor means, thereby obtaining data of measurement
values;
displaying means capable of performing color
display;
storing means storing data of display colors
10 respectively corresponding to the data of the
measurement values obtained by the sensor driving
circuit means;
reading means for reading data of a display color
corresponding to data of a measurement value obtained
15 by the sensor driving circuit means from the data of
display colors stored in the storing means; and
display control means for driving the displaying
means to perform display in a color corresponding to
the data of the display color read by the reading
20 means.
2. The electronic device sensor according
to claim 1, wherein the sensor means includes
a temperature sensor for measuring a temperature.
3. The electronic device according to claim 1,
25 wherein the sensor means includes a pressure sensor
for measuring a pressure.
4. The electronic device according to claim 1,

wherein the displaying means is constructed by a liquid crystal color display.

5 5. The electronic device according to claim 1,
wherein the storing means stores data of a plurality of
display colors respectively corresponding to the
measurement values and the display control means drives
the display means to perform display in the plurality
of display colors.

10 6. The electronic device according to claim 1,
further comprising operation switch means for operating
the sensor driving circuit means.

7. The electronic device according to claim 1,
further comprising clock means for displaying time.

15 8. The electronic device according to claim 1,
wherein the display means includes a display for
displaying the data of measurement values obtained by
the sensor driving circuit means in the display colors.

20 9. The electronic device according to claim 1,
further comprising operation switch means for setting
and storing the data of display colors in the storing
means.

10. An electronic device with a sensor comprising:
a temperature sensor for detecting a temperature
of snow;

25 displaying means capable of performing color
display;

first storing means storing data of display colors

representing index colors of ski wax of ski wax makers;

second storing means for storing a ski wax maker selected by an operator;

5 reading means for reading, from the first storing means, data of a display color corresponding to the temperature of snow obtained by the temperature sensor and data of a display color corresponding to the ski wax maker stored in the second storing means; and

10 display control means for causing the displaying means to display the temperature of snow detected by the temperature sensor in the display color read by the reading means.

11. The electronic device according to claim 10, wherein the displaying means is a liquid crystal color display.
15

12. The electronic device according to claim 10, wherein the first storing means is constructed by a storage for storing data of a plurality of display colors respectively corresponding to temperatures of snow and the display control means causes the display means to perform display in the plurality of display colors.
20

13. The electronic device according to claim 10, further comprising operation switch means for operating the temperature sensor.
25

14. The electronic device according to claim 10, further comprising clock means for displaying time.

15. The electronic device according to claim 10,
wherein the temperature sensor is a radiation type
temperature sensor.

5 16. The electronic device according to claim 10,
further comprising operation switch means for setting
and storing the data of display colors in the first
storing means.

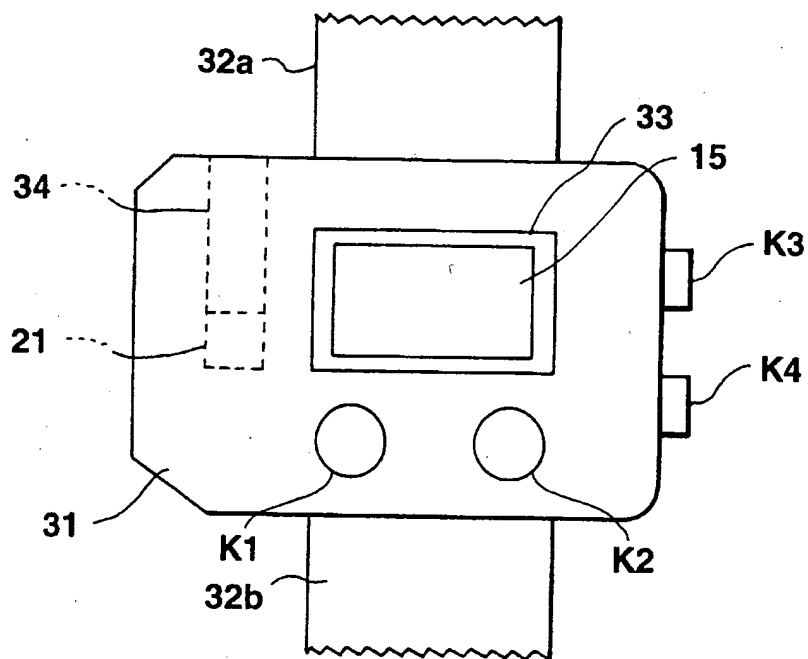


FIG.1

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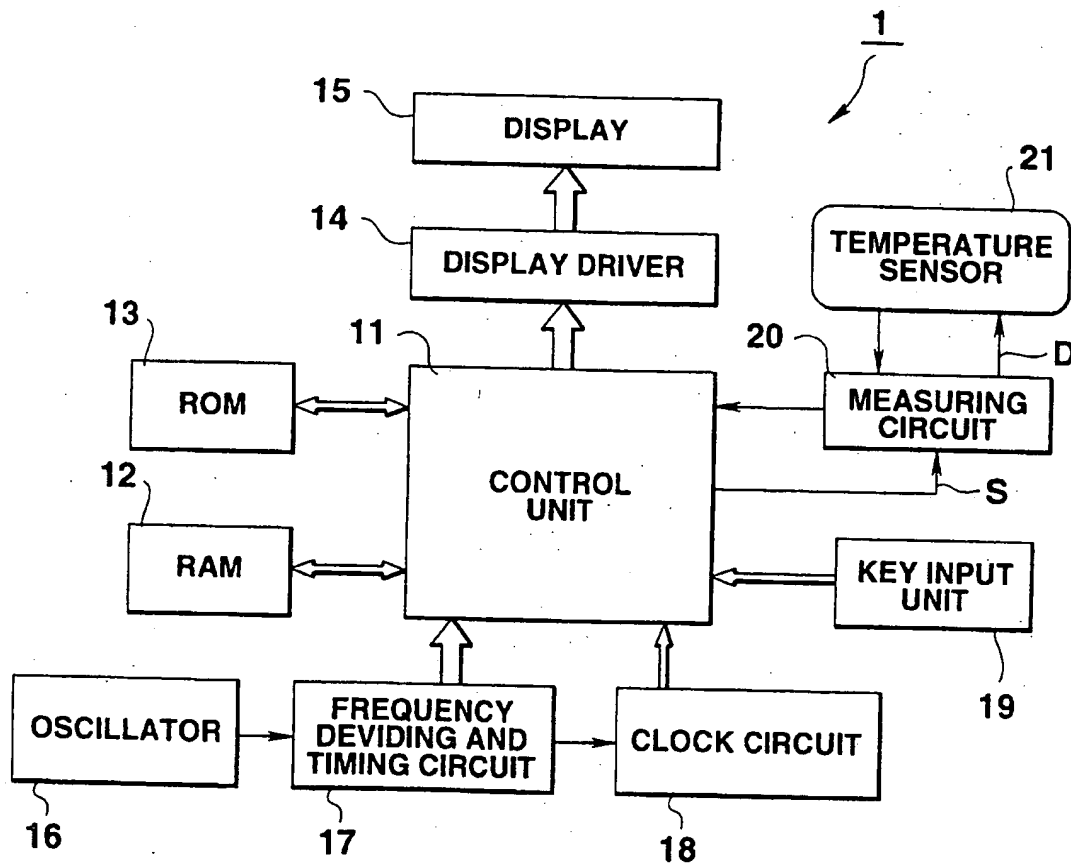
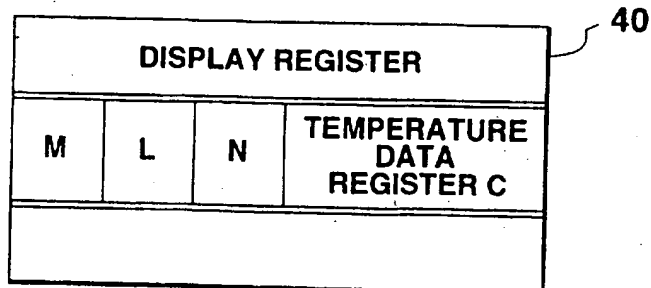


FIG.2

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**FIG.3****COLOR CONVERSION TABLE**

TEMPERATURE °C	COMPANY COMPANY COMPANY		
	A (N = 0)	B (N = 1)	C (N = 2)
0	3, 6	4, 6	4, 6
-1	3, 6	4, 6	4, 6
-2	3, 6	4, 6	4, 6
-3	3, 6	4, 6	4, 2
-4	3, 6	4, 6	4, 2
-5	3, 2	4, 6	2, 6
-6	2, 6	4, 6	2, 6
-7	2, 6	4, 6	2, 6
-8	2, 1	4, 2	2, 5
-9	2, 1	2, 6	2, 5
-10	2, 1	2, 6	5, 6
-11	1, 6	2, 6	5, 6
...			
-16	1, 6	2, 6	5, 6

FIG.4

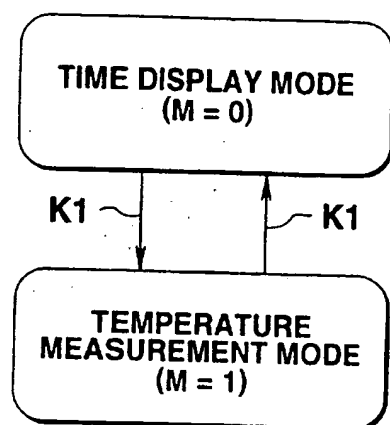


FIG.5

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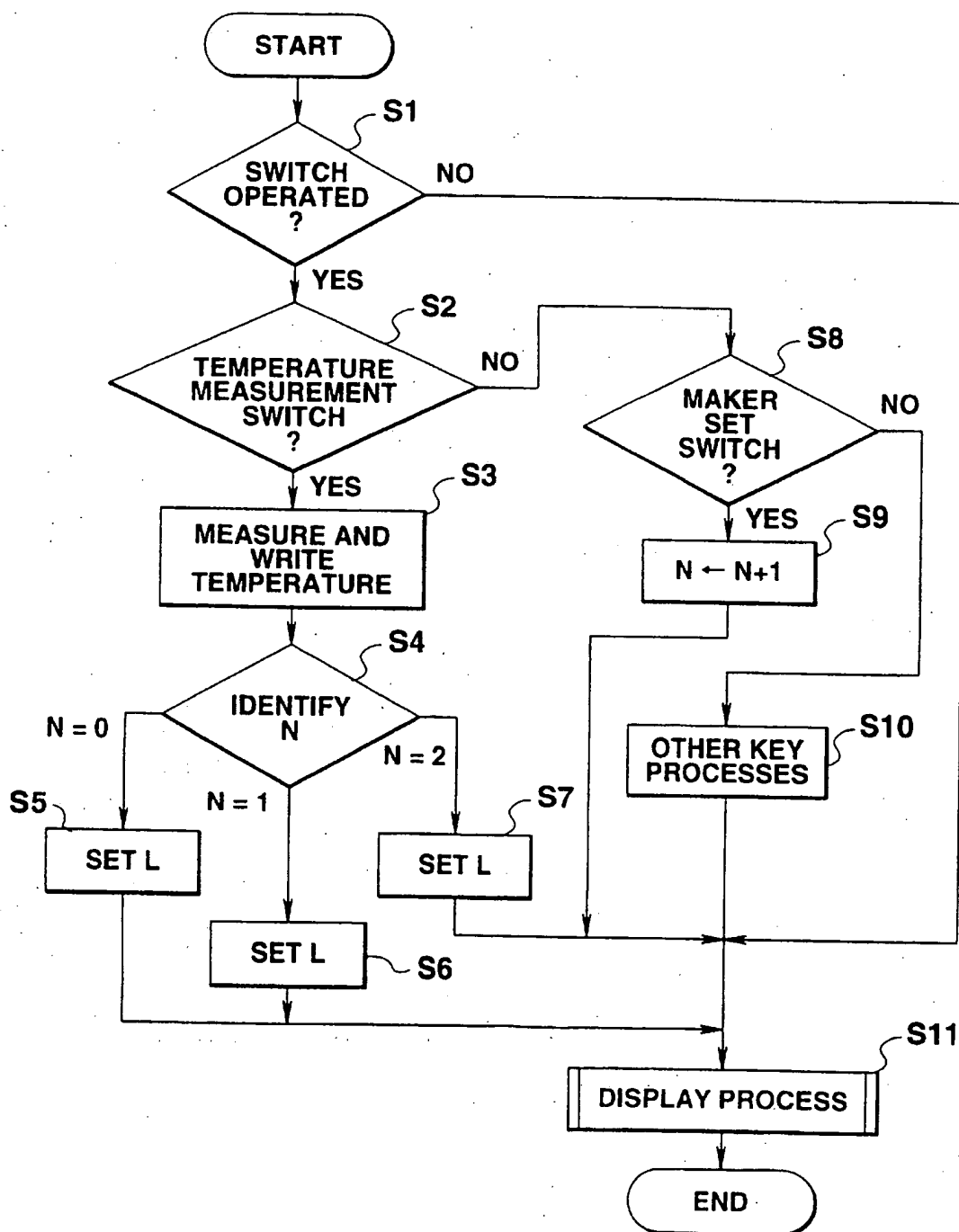


FIG.6

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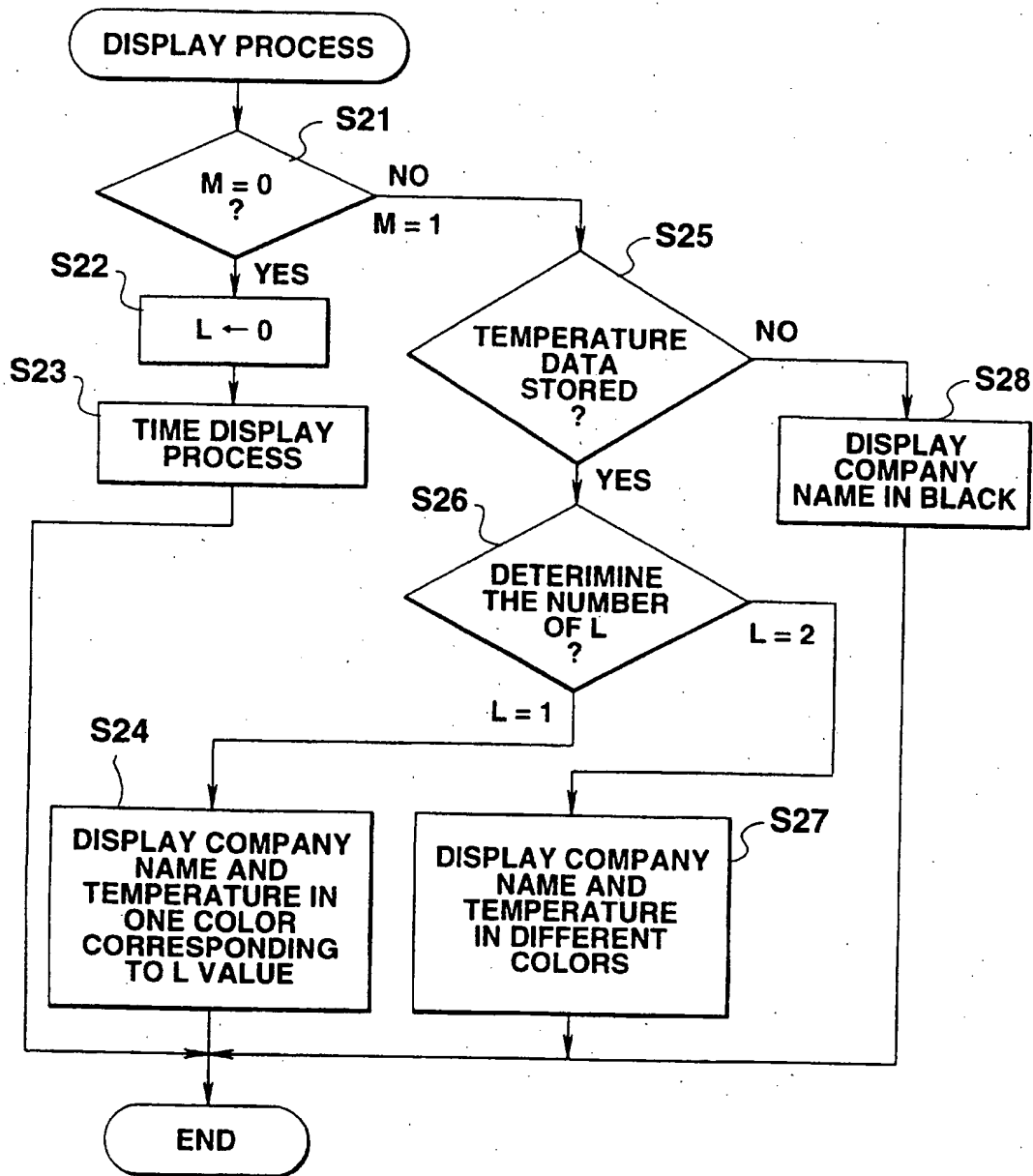


FIG.7

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DISPLAY REGISTER					40
M		L		N	TEMPERATURE DATA REGISTER C
P1	0		4		P4
P2	5		10		P5
P3	11		13		

FIG.8

INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 96/02753

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 G01D7/00 G01K1/02 G04G1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G01D G01K G04G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 687 340 (HAVEL) 18 August 1987 see column 12, line 12 - line 57; figures 29,30	1,5-9
Y	FR,A,2 611 521 (OPTION) 9 September 1988 see the whole document	2,10, 12-16
Y	DE,A,31 03 850 (OSTERWALD) 14 October 1982	2,10, 12-16
Y	see abstract; figures	2,10, 12-16
A	GB,A,2 023 311 (MONTRES ROLEX) 28 December 1979 see abstract	3
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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

3 December 1996

Date of mailing of the international search report

19.12.96

Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

Internat'l Application No
PCT/JP 96/02753

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR,A,2 667 026 (AUTOMOBILES PEUGOT) 27 March 1992 see claims 1-6 -----	4,11

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/JP 96/02753

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4687340	18-08-87	US-A- 4647217	03-03-87
		CA-A- 1232144	02-02-88
		GB-A- 2186400	12-08-87
		US-A- 4707141	17-11-87
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		US-A- 4965561	23-10-90
		US-A- 4845481	04-07-89
		US-A- 4705406	10-11-87
		US-A- 4771274	13-09-88

FR-A-2611521	09-09-88	NONE	

DE-A-3103850	14-10-82	NONE	

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FR-A-2667026	27-03-92	NONE	

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